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FIG. 1A

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FIG. 1B

ACCELERATION SENSOR (116)

ANGLE SENSOR (117)

FIG. 2

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200

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START

WEAR FINGER DEVICE — S210

RECEIVE SENSOR SIGNALS FROM FINGER DEVICE — S220

RECOGNIZE FINGER DEVICE BASED ON RECEIVED SENSOR SIGNALS — S230

CONFIGURE FIRMWARE BASED ON FINGER DEVICE RECOGNITION INFORMATION — S240

CONFIGURE DEVICE DRIVER BASED ON FINGER DEVICE RECOGNITION INFORMATION AND BASIC SET-UP INFORMATION — S250

INDICATE POSITIONS OF FINGERS ON SOFT KEYBOARD — S260

INTERPRET MOVEMENT CHARACTERISTIC INFORMATION AND INPUT INFORMATION — S270

END

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FIG. 3A

PRE-PROCESSING UNIT

140

SIGNAL-PROCESSING UNIT

FINGER MOVEMENT INFORMATION, FINGER DEVICE RECOGNITION INFORMATION

130

137 OUTPUT VALUE TRANSMITTING UNIT

136 OUTPUT VALUE CALCULATING UNIT

135 PORT CHANGE RECOGNIZING AND STORING UNIT

131 FIRST PORT

132 SECOND PORT

133 THIRD PORT

134 FOURTH PORT

110

111 FIRST SENSOR

112 SECOND SENSOR

113 THIRD SENSOR

114 FOURTH SENSOR

FIG. 3B

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300

```
        ( START )
            │
            ▼
┌─────────────────────────┐
│       INITIALIZE         │ ── S310
│  HARDWARE AND SOFTWARE   │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│  RECEIVE SENSOR SIGNALS  │ ── S320
│    FROM FINGER DEVICE    │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│  RECOGNIZE WHETHER USER  │
│  IS WEARING FINGER DEVICE│ ── S330
│    AND FINGER POSITIONS  │
│      OF FINGER DEVICE    │
└─────────────────────────┘
            │
            ▼
┌─────────────────────────┐
│  TRANSMIT SENSOR OUTPUT OF│
│   WORN FINGER DEVICE AND  │
│ FINGER DEVICE RECOGNITION │ ── S340
│       INFORMATION TO      │
│  SIGNAL-PROCESSING UNIT   │
└─────────────────────────┘
            │
            ▼
        ( END )
```

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FIG. 4A

PRE-
PROCESSING
UNIT

130

FINGER
MOVEMENT
INFORMATION,
FINGER
DEVICE
RECOGNITION
INFORMATION

SIGNAL-PROCESSING UNIT

140

FINGER DEVICE
SELF-
CONFIGURING
UNIT

141

FINGER
MOVEMENT
INFORMATION
PROCESSING
UNIT

142

MOVEMENT
CHARACTERISTIC
INFORMATION,
FINGER
DEVICE
RECOGNITION
INFORMATION

DEVICE
DRIVER

160

FIG. 4B

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```
                              400
                          START

        ┌──────────────────────────────┐
        │         INITIALIZE            │
        │   HARDWARE AND SOFTWARE       │── S410
        └──────────────────────────────┘

        ┌──────────────────────────────┐
        │    RECEIVE FINGER DEVICE      │
        │  RECOGNITION INFORMATION AND  │── S420
        │  FINGER MOVEMENT INFORMATION  │
        └──────────────────────────────┘

        ┌──────────────────────────────┐
        │   DEACTIVATE ALGORITHMS OF    │
        │  FINGER DEVICE WHICH ARE NOT  │
        │  WORN BY USER AND CONFIGURE   │── S430
        │   FIRMWARE BASED ON FINGER    │
        │  DEVICE RECOGNITION INFORMATION │
        └──────────────────────────────┘

        ┌──────────────────────────────┐
        │     PERFORM ALGORITHMS        │
        │  USED TO PROCESS SIGNALS      │
        │ OUTPUTTED FROM FINGER DEVICE  │── S440
        │        WORN BY USER           │
        └──────────────────────────────┘

        ┌──────────────────────────────┐
        │     TRANSMIT MOVEMENT         │
        │ CHARACTERISTIC INFORMATION AND │
        │  FINGER DEVICE RECOGNITION    │── S450
        │ INFORMATION TO DEVICE DRIVER  │
        └──────────────────────────────┘

                          END
```

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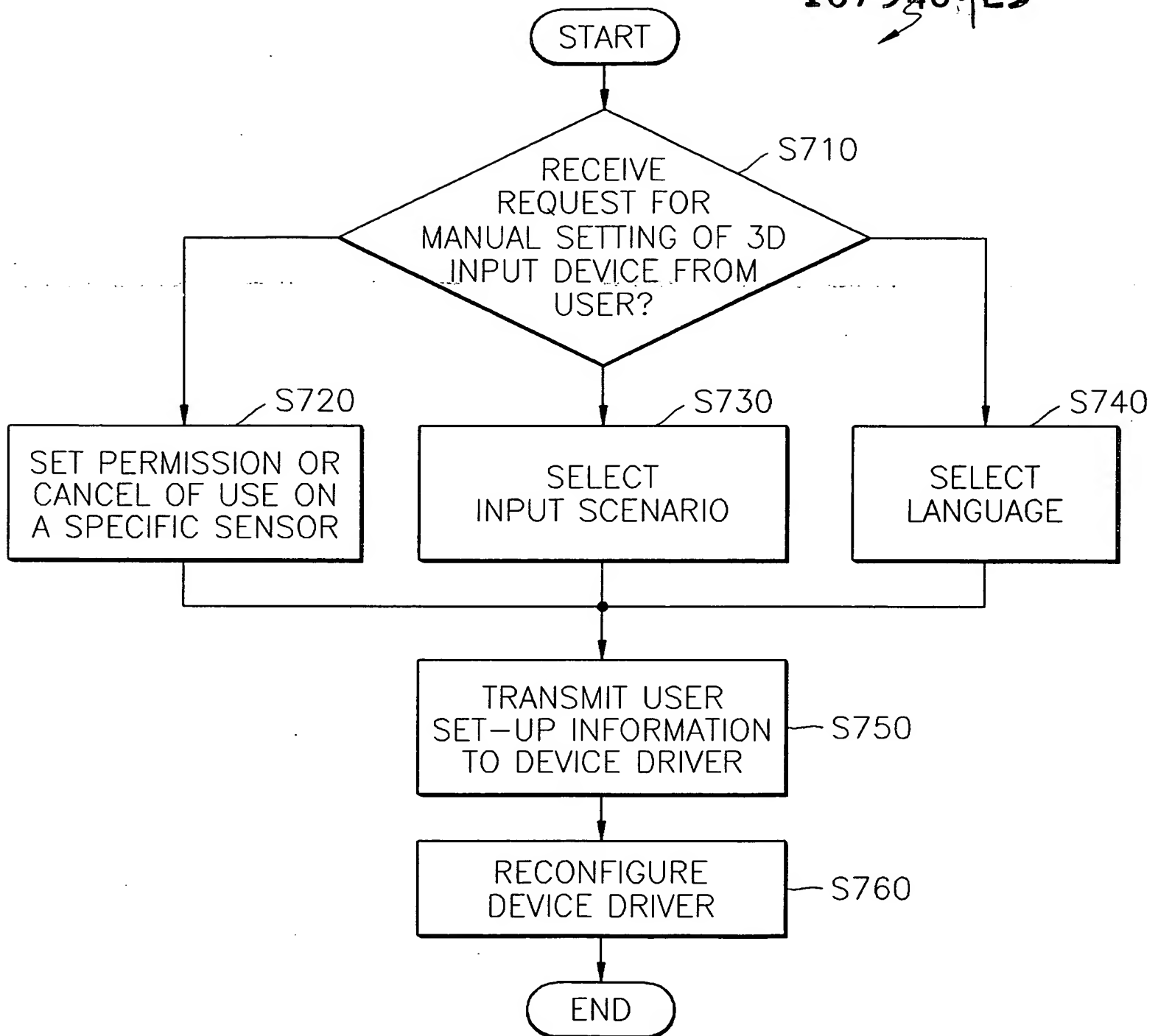FIG. 5A

SIGNAL-PROCESSING UNIT — 140

FINGER-DEVICE RECOGNITION INFORMATION, MOVEMENT CHARACTERISTIC INFORMATION

DEVICE DRIVER — 160

DEVICE DRIVER CONFIGURING/RECONFIGURING UNIT — 161

SET-UP INFORMATION AND MOVEMENT CHARACTERISTIC INFORMATION FORWARDING UNIT — 162

BASIC SET-UP INFORMATION, MOVEMENT CHARACTERISTIC INFORMATION

APPLICATION — 170

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FIG. 5B

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START

INITIALIZE ITSELF AND APPLICATION — S510

ACQUIRE FINGER DEVICE RECOGNITION INFORMATION AND MOVEMENT CHARACTERISTIC INFORMATION FROM SIGNAL—PROCESSING UNIT — S520

CONFIGURE/RECONFIGURE ITSELF BASED ON ACQUIRED FINGER DEVICE RECOGNITION INFORMATION AND SET—UP INFORMATION — S530

IS THERE CALL FROM SIGNAL—PROCESSING DEVICE? — S540

YES → ACQUIRE FINGER DEVICE RECOGNITION INFORMATION FROM SIGNAL—PROCESSING DEVICE — S550

NO

IS THERE CALL FROM APPLICATION? — S560

YES → ACQUIRE BASIC SET—UP INFORMATION FROM APPLICATION — S570

NO

FORWARD MOVEMENT CHARACTERISTIC INFORMATION AND SET—UP INFORMATION TO APPLICATION — S580

END

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FIG. 6A

OUTPUT
DEVICE — 180

APPLICATION — 170

SOFT
KEYBOARD
DISPLAYING
UNIT — 171

MOVEMENT
CHARACTERISTIC
INTERPRETING
UNIT — 172

INFORMATION
INPUT UNIT — 173

USER SETTING UNIT — 174

MOVEMENT
CHARACTERISTIC
INFORMATION,
BASIC
SET–UP
INFORMATION

DEVICE
DRIVER — 160

FIG. 6B

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```
                    ┌─────────┐
                    │  START  │
                    └────┬────┘
                         │
                         ▼
 ┌───────────────────────────────────┐
 │  RECEIVE SET-UP INFORMATION        │
 │        AND MOVEMENT                │─── S610
 │  CHARACTERISTIC INFORMATION        │
 │      FROM DEVICE DRIVER            │
 └─────────────────┬─────────────────┘
                   │
                   ▼
 ┌───────────────────────────────────┐
 │  DISPLAY POSITIONS OF FINGERS      │
 │  ON SOFT KEYBOARD BASED ON         │─── S620
 │    RECEIVED BASIC SET-UP           │
 │  INFORMATION TO OUTPUT DEVICE      │
 └─────────────────┬─────────────────┘
                   │
                   ▼
 ┌───────────────────────────────────┐
 │      INTERPRET MOVEMENT            │─── S630
 │  CHARACTERISTIC INFORMATION        │
 └─────────────────┬─────────────────┘
                   │
                   ▼
 ┌───────────────────────────────────┐
 │  INPUT INFORMATION BASED ON        │─── S640
 │     INTERPRETED RESULT             │
 └─────────────────┬─────────────────┘
                   │
                   ▼
              ┌─────────┐
              │   END   │
              └─────────┘
```

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FIG. 7

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START

S710 — RECEIVE REQUEST FOR MANUAL SETTING OF 3D INPUT DEVICE FROM USER?

S720 — SET PERMISSION OR CANCEL OF USE ON A SPECIFIC SENSOR

S730 — SELECT INPUT SCENARIO

S740 — SELECT LANGUAGE

S750 — TRANSMIT USER SET-UP INFORMATION TO DEVICE DRIVER

S760 — RECONFIGURE DEVICE DRIVER

END

FIG. 8

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800

SOFT KEYBOARD		▭ ▣ ☒
a – b – c	– d – e – f	g – h – i
j – k – l		m – n – o
p – q – r	s – t – u – v	w – x – y – z
Caps	Enter	123

FIG. 9

CONTROL BOARD   ▫ ⧉ ⊠

910

3D KEYBOARD REGISTRATION INFORMATION   ▫ ⧉ ⊠

KEYBOARD TYPE — 920

- ◉ KEYBOARD FOR RIGHT HAND
- ○ KEYBOARD FOR LEFT HAND
- ○ KEYBOARD FOR BOTH HANDS

KEY ARRANGEMENT — 930

- ○ ABC TEXT TYPE
- ◉ QWERTY HAND TYPE
- ○ CELLULARPHONE TYPE

SELECTION OF FINGERS — 940

- ○ ONE—FINGER
- ○ TWO—FINGERS
- ○ THREE—FINGERS
- ◉ FOUR—FINGERS

LANGUAGE — 950

- ○ ENGLISH
- ◉ KOREAN

960   970   980

| CONFIRM | | CANCEL | | APPLY |

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FIG. 10

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START

INITIALIZE SYSTEM ─── S1010

↓

ACQUIRE SENSOR SIGNALS
FROM FINGER DEVICE ─── S1020

↓

CALCULATE DUTY RATIO
OF RECEIVED SIGNAL ─── S1030

↓

RECOGNIZE WHETHER
USER IS WEARING
FINGER DEVICE BASED ON ─── S1040
RECEIVED SENSOR SIGNALS

↓

TRANSMIT SIGNAL VALUES
HAVING CALCULATED
DUTY RATIO AND
AN IDENTIFICATION ─── S1050
FACTOR TO
SIGNAL─PROCESSING UNIT

↓

END

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FIG. 11

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START

RECEIVE CURRENT PORT VALUES — S1110

IS THERE ANY
CHANGE BETWEEN
CURRENT PORT VALUES AND
PREVIOUS PORT
VALUES? — S1120

NO

YES

STORE CURRENT PORT VALUES
AND INFORMATION ON PORTS
HAVING PORT VALUE CHANGES
IN PORT STATUS VARIABLES — S1130

STORE TIMER VALUE AT
CURRENT TIME WHEN PORT
STATUS VARIABLES ARE
WRITTEN WITH PORT VALUES
AND PORT INFORMATION
IN EVENT TIME VARIABLE — S1140

A

FIG. 12

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1200

(A)

CAN THREE EDGE-TRIGGERED-TIMES BE OBTAINED FROM EACH SENSOR?
time[0], time[1] time[2] — S1210

NO

YES

STORE ERROR VALUE IN OUTPUT VARIABLE — S1240

STORE INITIAL EDGE STATE FOR EACH SENSOR — S1220

CALCULATE SCALE VALUE BASED ON EVENT TIME VARIABLES AND STORE CALCULATED SCALE VALUE TO OUTPUT VARIABLE — S1230

STORE MINIMUM THRESHOLD IN OUTPUT VARIABLE IF STORED SCALE VALUE IS LESS THAN MINIMUM THRESHOLD — S1250

STORE MAXIMUM THRESHOLD IN OUTPUT VARIABLE IF STORED SCALE VALUE IS GREATER THAN MAXIMUM THRESHOLD — S1260

(B)

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FIG. 13

B1

1300

CHECK OUTPUT VARIABLE
STORING ERROR VALUE AND
STORE OUTPUT VARIABLE IN
NO−SIGNAL VARIABLE   — S1310

TRANSMIT OUTPUT VARIABLE
AND VALUE INCLUDED IN
NO−SIGNAL VARIABLE TO
SIGNAL−PROCESSING UNIT   — S1320

END

FIG. 14

START

1400

INITIALIZE SYSTEM   — S1401

DOES
INTERRUPT   — S1402
OCCUR?

NO

YES

A

FIG. 15A

1500

(A)

INITIALIZE VARIABLES :
TRANSITION_COUNTER=0, INPUT_COUNTER=0 — S1501

INPUT CURRENT PORT VALUE INTO CURRENT_INPUT AND
PREVIOUS PORT VALUE INTO LAST_INPUT: VARIABLE
IN WHICH CURRENT ACQUISITION OF N (THE NUMBER OF
FINGERS HAVING SENSOR ATTACHED THERETO) PORTS IS
SEQUENTIALLY STORED, LAST_INPUT= CURRENT_INPUT — S1502

TRANSITION_COUNTER < Ntc ? — S1503 → NO (B)

↓ YES

CURRENT_INPUT: CAPTURE CURRENT PORT SIGNAL — S1504

PERFORM SIGNAL COMBINATION
VXOR = (CURRENT_INPUT) XOR (LAST_INPUT) :
DETERMINE WHETHER THERE IS ANY CHANGE BETWEEN
CURRENT PORT SIGNAL AND PREVIOUS PORT SIGNAL — S1505

VXOR IS 0 ? — S1506 → YES

↓ NO

MANIPULATE VARIABLE
TRANSITION_COUNTER = TRANSITION_COUNTER+1
PORT_STATUS [INPUT_COUNTER] =
(N−BIT LEFT SHIFT CURRENT_INPUT) + VXOR EVENT_TIME
[INPUT_COUNTER] = CURRENT TIMER VALUE — S1507

INPUT_COUNTER = INPUT_COUNTER+1 — S1508

IF INPUT_COUNTER > Nic ? — S1509 → YES (B)

↓ NO

LAST_INPUT=CURRENT_INPUT — S1510

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FIG. 15C

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FIG. 15D

N-BIT LEFT SHIFTED CURRENT_INPUT

0	1	1	1	0	0	0

$\oplus$

VXOR

0	0	0	0	1	0	0

PORT_STATUS

0	1	1	1	0	0	0

X4 X3 X2 X1 ← CURRENT INPUT VALUE FROM SENSOR

X4 X3 X2 X1 ← EDGE-TRIGGERED SENSOR

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FIG. 15E

INPUT COUNTER	CURRENT_INPUT	LAST_INPUT	VXOR	TRANSITION_COUNTER	PORT_STATUS[ ]	EVENT_TIME[ ]
0	0000 0101					
1	0000 0111	0000 0101	0000 0000	1	0111 0010	10
2	0000 1111	0000 0111	0000 1000	2	1111 1000	50
3	0000 1110	0000 1111	0000 0001	3	1110 0001	130
4	0000 1010	0000 1110	0000 0010	4	1010 0100	160
5	0000 1000	0000 1010	0000 1000	5	1000 0010	170
6	0000 0000	0000 1000	0000 1000	6	0000 1000	210
7	0000 0001	0000 0000	0000 0001	7	0001 0001	280
8	0000 0101	0000 0001	0000 0100	8	0101 0100	300
9	0000 0111	0000 0101	0000 0010	9	0111 0010	320
10	0000 1111	0000 0111	0000 1000	10	1111 1000	360
11	0000 1110	0000 1111	0000 0001	11	1110 0001	430
	0000 1010	0000 1110	0000 0100	12	1010 0100	450

FIG. 16A

(B)

Bit_Mask = 0x01, count = 0 —— S1601

—— S1602
(E) → count < N ? → NO → (F)

YES

Edge_Counter = 0 —— S1603

Port_Status_Counter = 0 —— S1604

—— S1605
Port_Status_Counter < Input_Counter +1 ? → NO → (D)

YES

—— S1606
{(Port_Status [Port_Status_Counter]) AND_bit (Bit_Mask)} is 0 ? → YES

NO —— S1607

Time[Edge_Counter] = Event_Time[Port_Status_Counter]

—— S1608
Edge_Counter is 0 ? → NO

YES —— S1609

Init_Edge_Status = {(Port_Status[Port_Status_Counter]) AND_bit (N−bit Left Shifted Bit_Mask)}

—— S1610
Edge_Counter = Edge_Counter + 1

—— S1611
Edge_Counter > 2 ? → YES → (C)

NO —— S1612

Port_Status_Counter = Port_Status_Counter + 1

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FIG. 16B

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PORT-STATUS[3]

✕	✕	✕	✕	0	0	0	1

AND-BIT

BIT_MASK

0	0	0	0	0	0	0	1

FIG. 16C

PORT-STATUS

1	1	1	0	✕	✕	✕	✕

AND-BIT   AND-BIT

N-BIT LEFT SHIFTED
BIT_MASK

0	0	0	1	0	0	0	0

INIT_EDGE_STATUS

0

FIG. 16D

	X1	X2	X3	X4
Init_Edge_Status	0	1	0	1
Time[0]	130	10	160	50
Time[1]	280	170	300	210
Time[2]	430	320	450	360

FIG. 17

C

S1701

Init_Edge_Status is 0 ?

YES

S1703

Output[count]
= Scale_Factor
* (Time[2] − Time[1])
/(Time[2] − Time[0])

NO

S1702

Output[count]
= Scale_Factor
* (Time[1] −Time[0])
/(Time[2] − Time[0])

S1704

Output[count] < Min_Value ?

YES

NO

S1706

Output[count] > Max_Value ?

YES

S1707

Output[count] =
Value_Something_Wrong

S1705

Output[count] =
Max_Value

NO

S1708

Output[count]
=Value_Something_Wrong

D

Bit_Mask =
1−bit Left Shifted Bit_Mask

S1709

count = count + 1

S1710

E

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FIG. 18A

F

S1801

Bit_Mask = 0x01
count =0
No_Exist_Signals = 0x00

S1802

count < N ?

NO

YES

S1803

Output[count] is
Value_Something_Wrong ?

NO

YES

S1804

No_Exist_Signals =
No_Exist_Signals + Bit_Mask

S1805

count = count + 1

S1806

Bit_Mask =
1−bit Left Shifted Bit_Mask

S1807

SIGNAL TRANSMISSION :
Output[1], ... , Output[N],
No_Exist_Signals

END

FIG. 18B

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NO_EXIST_SIGNALS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

+

BIT_MASK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

NO_EXIST_SIGNALS | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

+

1−BIT LEFT SHIFTED
BIT_MASK | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |

NO_EXIST_SIGNALS | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

X4   X3   X2   X1
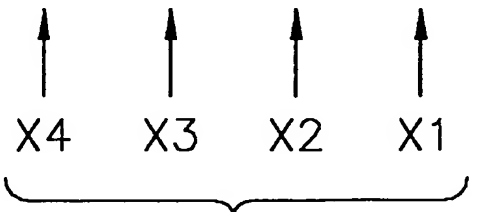
SENSOR OUTPUTTING
ERROR VALUE

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FIG. 19

START

X1

X2

X3

X4

10ms

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FIG. 20